FURTHER STUDIES OF THE MYRMICINE STING APPARATUS: *EUTETRAMORIUM, OXYOPOMYRMEX,* AND *TERATANER* (HYMENOPTERA, FORMICIDAE)*

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Introduction

In an earlier investigation (Kugler, 1978, 1979) I described the sting apparatus of representatives of 63 genera of myrmicine ants. In so doing, it was shown that this complex structure has clear potential for defining myrmicine genera and perhaps generic groupings. Furthermore, its morphology may have played an important role in the evolution of some genera.

Here I present descriptions of members of 3 genera that could not be included in that work. Structural affinities with the sting apparatus of other genera are discussed in order to assist those reclassifying this taxonomically problematical subfamily.

Methods

The materials and methods used are described in detail in Kugler (1978). For the sake of brevity, figures from that earlier study are cited here in italics; new figures of this paper are cited in Roman type. Voucher specimens are deposited in the Harvard Museum of Comparative Zoology, labeled "Kugler study 1978." Scale lines in the figures are in millimeters.

Eutetramorium

Species examined: *E. mocquerysi,* 2 workers.

Spiracular plate: (Fig. 1) Body subtriangular, only slightly longer than wide. Anterior apodeme wide along nearly whole length, ending abruptly near dorsal margin of plate. Ventral and posterior

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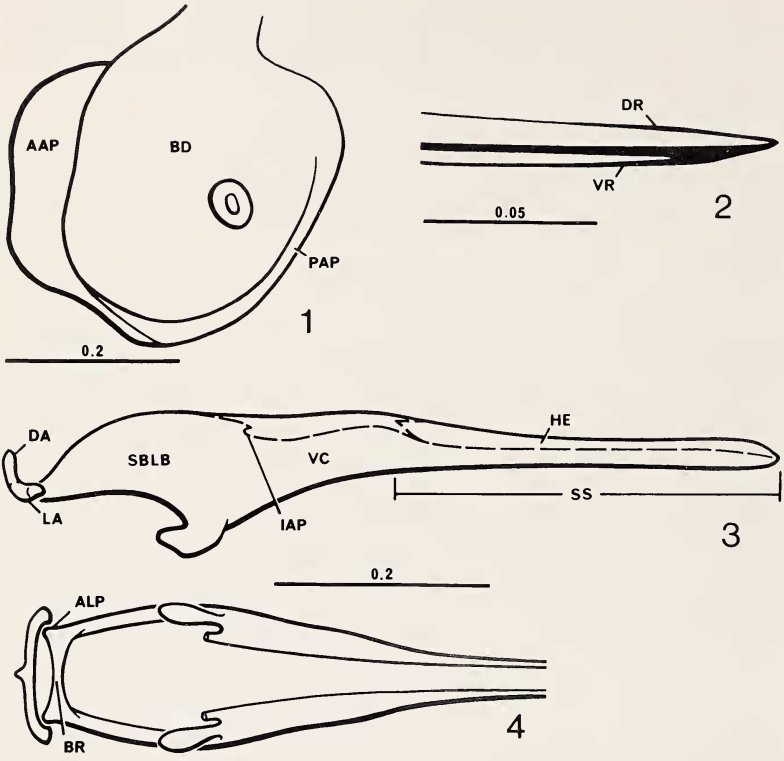


Figures 1–4. Sclerites of the sting apparatus of *Eutetramorium mocquerysi*. Fig. 1, spiracular plate, side view. Fig. 2, apical ¼ of lancet, side view. Fig. 3, sting and furcula, side view. Fig. 4, sting and furcula, ventral view. Abbreviations: AAP, anterior apodeme; ALP, anterolateral process of sting base; BD, body; BR, basal ridge; DA, dorsal arm of furcula; DR, dorsal ridge; HE, hemocoel; IAP, internal apodeme; LA, lateral arm of furcula; PAP, posterior apodeme; SBLB, sting bulb; SS, sting shaft; VC, valve chamber; VR, ventral ridge.

apodemes present, well sclerotized. No dorsal notch or posterodorsal lobe. Spiracle relatively small, located caudad of center.

Quadrate plate: Body and apodeme both subrectangular, equal in width; body extends well ventrad of apodeme. Dorsal edge of plate convex, with moderately wide medial and lateral lobes terminating in an acute anterodorsal corner.

Anal plate: Very poorly sclerotized, ill-defined; no sensilla.

Oblong plate: Posterior arm with narrow, well sclerotized apodeme, body widens abruptly just caudad of articulation with fulcral arm, a lightly sclerotized ventral ridge arcs from intervalvifer articulation to opposite fulcral arm. Anterior apodeme wide, prominent, bluntly rounded. Ventral arm wide, broadly spindle-shaped fulcral arm meets posterior arm perpendicularly, postincision deep.

Gonostylus: Two-segmented as indicated by bimodal sensilla pattern and ill-defined membranous region; evenly tapered to end, neither long and slender nor short and wide, not strongly dorsoventrally compressed. Distal segment with 7 long setae and isolated dorsoterminal chaeta; proximal segment with 10 setae of varied lengths. Distal segment grades evenly into terminal membrane. No distal notch or basiconic sensilla.

Triangular plate: Body wide, basal portion abruptly tapered; ventroapical process a distinct extension from body, narrowly rounded apically. Dorsal and medial tubercles present.

Lancet: (Fig. 2) Straight, acute, well sclerotized, with distinct ventral ridge and, distally, a dorsal ridge. Each lancet with 2 valves of moderate size; the caudal one smaller, less sclerotized. No barbs present.

Sting: (Figs. 3, 4) Long, slender, well sclerotized; sting bulb, valve chamber and sting shaft regions distinguishable in profile. Sting base not arched, anterolateral processes present. Valve chamber internally much lower than sting bulb. Sting shaft with distinct hemocoel throughout length, height of hemocoel greater apically than subapically. No terminal flange. Campaniform sensilla present on sting shaft and distal 2/3 of valve chamber. Index of reduction 26.8.

Furcula: (Figs. 3, 4) T-shaped in anterior view, lateral arms wrap around sting base, dorsal arm well developed.

Discussion

The sting apparatus of *Eutetramorium mocquerysi* seems most closely related to those of the Tetramoriini and the *Leptothorax* genus group (see Kugler, 1978). Some common characters are: the wide anterior apodeme and overall shape of the spiracular plate (*Fig. 57*); the medial and lateral lobes, and shape of the anterodorsal corner of the quadrate plate (*Fig. 58*); the shape of the anterior apodeme, ventral ridge and body of the posterior arm of the oblong

plate (*Figs. 52, 59*); much of the shape of the sting (*Figs. 55, 56*). The gonostyli are much like those of *Leptothorax* (*Fig. 53*), but not as long and narrow, and they lack the companion seta. The sting base and furcula have characteristics of those of *Liomyrmex* cf. *aurianus* (*Figs. 69, 70*).

In spite of its similarities with the Tetramoriini, *E. mocquerysi* lacks the dorsal flange on the end of the sting and the characteristically stubby gonostyli of that tribe. On the basis of the flange character and other external characters Bolton (1976) removed *Eutetramorium* from its traditional association with the Tetramoriini. He prefers to place it in the Myrmicini, but as an alternative hypothesis, based admittedly on one character system, I would suggest a position nearer *Leptothorax* and related genera.

Oxyopomyrmex

Species examined: *O. tuneticus,* 1 worker; *O. tuneticus* var. *thoracicus,* 1 worker.

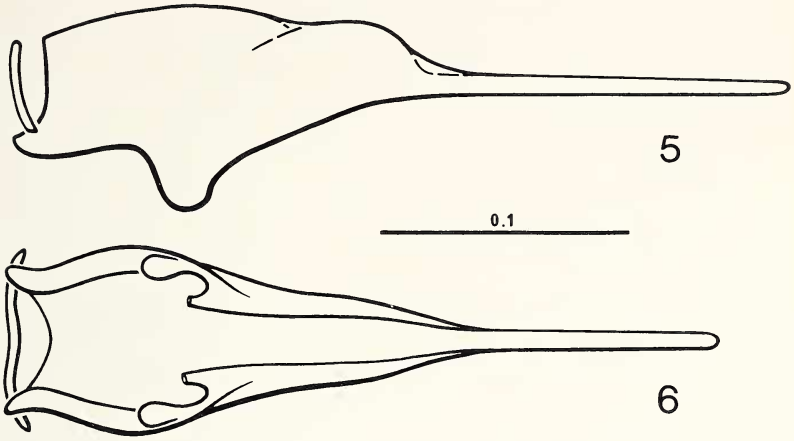
Spiracular plate: Body subrectangular, with straight anterior edge, slightly concave posterior edge and convex dorsal and ventral edges. Anterior apodeme forms a square anteroventral corner, then a thin margin along anterior edge to dorsad of body of plate; medial connection membranous. Large V-shaped dorsal notch present; no distinct posteroventral tubercle or posterodorsal lobe.

Quadrate plate: Subtriangular, both body and apodeme much narrowed at base. Dorsal edge straight, anterodorsal corner broadly rounded. Anterior edge poorly sclerotized, expecially dorsad.

Anal plate: Weakly sclerotized, longer than wide, with 4 long setae on terminal edge in *O. tuneticus,* 2 setae in *O. t.* var. *thoracicus.*

Oblong plate: Dorsal ridge and body of posterior arm long and narrow, uniform in width, without ventral ridge. Anterior apodeme very long and slender. Ventral arm tapered and subtruncate distally; fulcral arm slender, weak, diffuse dorsad, forming acute angle with posterior arm.

Gonostylus: In *O. t. thoracicus,* narrow from side view, with no indication of segmentation; 17–20 setae scattered more or less evenly along distal 2/3 of ventrolateral surface. Dorsoterminal chaeta, companion seta and terminal membrane present. No basiconic sensilla. Gonostyli of *O. tuneticus* lost in preparation.



Figures 5–6. Sting and furcula of *Oxyopomyrmex tuneticus.* Fig. 5, *O. tuneticus,* side view. Fig. 6, *O. tuneticus* var. *thoracicus,* ventral view.

Triangular plate: In *O. tuneticus* body and ventroapical process very slender and distinct; in *O. t.* var. *thoracicus* body wider dorsad and merging more with ventroapical process. In both specimens, body evenly tapered to ramus; neither dorsal nor medial tubercle present.

Lancet: Long, weak, and spatulate distally, with broadly rounded apex; about twice as deep as end of sting shaft. One large lancet valve per lancet.

Sting: (Figs. 5, 6) Sting bulb large with weak basal ridge and distinct anterolateral processes. Valve chamber well developed, clearly distinguishable from sting bulb and sting shaft in profile and in ventral view; internal apophysis long. Sting shaft short, very slender and weak; no dorsal flange. Index of reduction 21.9 for *O. tuneticus,* 20.4 for *O. t.* var. *thoracicus.*

Furcula: (Figs. 5, 6) Slender arch, uniform in diameter; no dorsal arm.

Discussion

The sting apparatus of *Oxyopomyrmex tuneticus* and *O. t.* var. *thoracicus* are very similar to those of *Messor* and *Aphaenogaster.* The large dorsal notch and thin anterior apodeme of the spiracular

plate (*Fig. 130*); the subtriangular quadrate plate (*Fig. 131*); the long slender posterior arm and anterior apodeme and the inclined fulcral arm of the oblong plate (*Figs. 132, 133*); and the shape of the sting bulb, valve chamber and furcula (*Figs. 138, 139*) are common characteristics of the species so far examined in these 3 genera. The *Oxyopomyrmex* species, however, are distinct in two important respects: the sting shaft has no dorsal flange (*Fig. 138*), and the lancets are spatulate and broadly rounded apically, rather than acute (*Fig. 137*).

The close affinities of *Oxyopomyrmex, Messor* and *Aphaenogaster* as suggested by the sting apparatus are consistent with the views advanced by Emery (1922) and Wheeler (1910: 139–140, 268; 1922).

Terataner

Species examined: *T. alluaudi,* 2 workers.

Spiracular plate: (Fig. 7) Body subrectangular. Anterior apodeme narrow, well sclerotized, continues dorsad to make completely sclerotized connection with opposite side. Dorsal notch and ventral and posterior apodemes present.

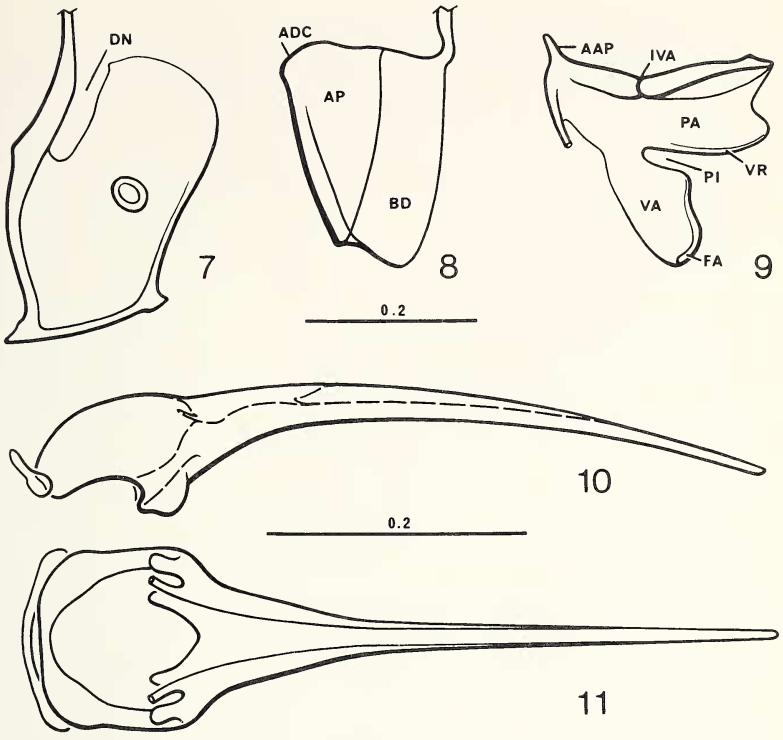
Quadrate plate: (Fig. 8) Apodeme subtriangular, no medial or lateral lobes, anterodorsal corner rounded. Body subrectangular, extending below apodeme.

Anal plate: Wider than long, clear suture between plate and anal arc; moderately well sclerotized proximally, posterior and lateral borders unsclerotized, undefined. Thirty-one long setae cover plate; no sensilla basiconica.

Oblong plate: (Fig. 9) Posterior arm short and straight, dorsal ridge strong, ventral ridge weak, ill-defined. Ventral arm wide apically with narrow fulcral arm perpendicular to posterior arm; postincision deep. Anterior apodeme rather short, acute.

Gonostylus: One-segmented. Dorsal surface free of sensilla, broadly triangular. Lateral surface narrower, uniformly and densely covered with long thin setae along distal ½ of length, longest setae proximad; small dorsoterminal chaeta embedded among setae; no obvious companion seta; no basiconic sensilla. Short terminal membrane present.

Lancet: Long, slender, weak and flagelliform. Two intermediate-sized valves per lancet, caudal valve smaller.



Figures 7–11. Sclerites of the sting apparatus of *Terataner alluaudi*. Fig. 7, spiracular plate, side view. Fig. 8, quadrate plate, side view. Fig. 9, oblong plate, side view. Fig. 10, sting and furcula, side view. Fig. 11, sting and furcula, ventral view. Abbreviations: AAP, anterior apodeme; ADC, anterodorsal corner; AP, apodeme; BD, body; DN, dorsal notch; FA, fulcral arm; IVA, intervalvifer articulation; PA, posterior arm; PI, postincision; VA, ventral arm; VR, ventral ridge.

Sting: (Figs. 10, 11) Sting bulb wide, with heavy basal ridge. Valve chamber small, indistinguishable from sting shaft in profile; topped by heavy internal ridge; 2 large ventrolaterally projecting prongs seem to originate on the internal apophysis. Sting shaft long, slender, tapering to weak apex; hemocoel clearly visible in basal 2/3. Index of reduction 20.1.

Furcula: (Figs. 10, 11) A simple low arch, no dorsal arm; extremities dilated at articulation with base of sting.

Discussion

The sting apparatus of *Terataner alluaudi* bears most resemblance to several genera normally considered unrelated by most modern myrmecologists. It has a variety of derived characters in common with *Atopomyrmex mocquerysi,* such as: shape of the anal plate; form of the gonostyli; long, flagelliform lancets (*Fig. 215*); form of the bulb, valve chamber and shaft of the sting, including 2 prongs extending into the sting bulb from the internal apophysis (*Figs. 216, 217*). These species, however, differ markedly in the shapes of the spiracular and oblong plates, and in the lack of a furcula and anal setae in *A. mocquerysi.* With the Cephalotini, *T. alluaudi* shares the following characters: complete medial connection of the anterior apodeme of the spiracular plate (may not be derived); anal plate wider than long and with numerous dorsal sensilla; long, well-defined fulcral arm of the oblong plate; gonostylus shape and setation (*Fig. 192*); shape of the lancets (*Fig. 194*); sting bulb shape, low valve chamber and flagellate sting shaft as in *Procryptocerus scabriusculus* (*Figs. 196, 197*). The main differences are the shape of the spiracular plate (*Fig. 198*); and in *T. alluaudi* the lack of the long pollicate anterodorsal process of the quadrate plate (*Figs. 189, 198*), the furcula not appressed to the sting base, the more elongate sting shaft containing a hemocoel, and the prongs in the sting bulb (cf. *Figs. 190, 191, 196, 197*). With *Cataulacus tardus, T. alluaudi* shares the medial connection of the spiracular plate anterior apodemes; the shape and setation of the gonostyli; flagelliform lancets (though much shorter in *C. tardus*); and prongs in the sting bulb (the number of which is different, *Figs. 203, 204*). Such prongs are known only from *Terataner, Atopomyrmex* and *Cataulacus.*

Both Emery (1922) and Wheeler (1922) placed *Terataner* in the tribe Myrmecinini with *Podomyrma, Lordomyrma, Atopomyrmex, Myrmecina, Pristomyrmex* and *Acanthomyrmex,* along with other genera, the stings of which have not yet been examined. Emery more specifically placed it with the first 3 genera in the subtribe Podomyrmiti after earlier creating the genus *Terataner* from some of the species then in *Atopomyrmex* (Emery, 1912). The sting apparatus does not support the groupings of the above genera into tribe Myrmecinini (see also discussions in Kugler, 1978), but the view of *Terataner* and *Atopomyrmex* as distinct, related genera is seen here as likely. Sting apparatus morphology also suggests a relationship

between *Terataner,* the Cephalotini and possibly *Cataulacus* that should be considered in future classifications of the Myrmicinae.

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